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Contact: Michael P. Kleiman
Phone: 505-846-4704

Firm foundation laid for premier research and development spacecraft

Demonstration and Science Experiments satellite will provide advanced technology to enhance war fighter communication, surveillance, and navigation when launched in 2008

In 2004, the future of spacecraft dedicated to research and development arrived with the initiation of the Demonstration and Sciences Experiments (DSX) space flight program.

Planned to launch in 2008 and inserted in a medium-earth orbit of 10,000 kilometers, DSX will conduct experiments to advance the warfighter's communication, surveillance, and navigation capabilities.



"It is designed to be the highly ambitious, as well as one of the largest research and development spacecraft flown by AFRL," Dr. Greg Spanjers, DSX program manager, said. "The program started in January 2004, and at this point, we are pleased to be ahead of the baseline plan for both schedule and budget."

Originally conceived by researchers at the Air Force Research Laboratory, Space Vehicles Directorate, Kirtland Air Force Base, N.M., over two years ago for physics-based experimental objectives, DSX will consist of parts provided by approximately 15 different entities from the public and private sectors, industry, Dept. of Defense, National Aeronautics and Space Administration and academia. In addition, the spacecraft will carry science experiment payloads from the Defense Advanced Research Projects Agency (DARPA), Arlington, Va., NASA Goddard Space Flight Center, Greenbelt, Md., and the Air Force Research Laboratory's Propulsion and Space Vehicles Directorates.

Although scheduled for launch in three years, the project has milestones to achieve in the upcoming months and years including a preliminary design review of the spacecraft system this fall and a critical design review of the satellite in early 2006. Typical spacecraft programs will initiate fabrication only after the critical design review process. On the other hand, judicious use of standardized mechanical and electrical interfaces has enabled DSX to initiate fabrication on an accelerated schedule. Flight hardware fabrication is currently being performed for the spacecraft structure, avionics, and several of the space weather payloads.

By mid-2007, the spacecraft bus will arrive at the Space Vehicles Directorate's Aerospace Engineering Facility on Kirtland AFB, initiating a six-month payload assembly integration and test phase. Following these required procedures, the 400-kilogram spacecraft will be prepared for launch to an orbit regime known as the medium-earth Orbit (MEO) slot region.

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505.846.4704/4321

Space Vehicles Directorate

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This particular area, between about 8,000 and 12,000 kilometers, represents an attractive orbit for future communications and surveillance satellites because it has a lower radiation dose rate and sufficient altitudes to allow for global coverage. In addition, it is four times closer than geostationary (GEO) satellites, which increases communications speed by a factor of eight. This attractive orbit has remained largely unexplored, with most commercial, military, and science satellites opting for low-earth orbit (LEO) or GEO orbits.

A majority of the research satellites fly in LEO, between 400 and 2,000 kilometers, to reduce problems caused by radiation. A primary goal of DSX, however, is to conduct the characterization and basic research on the MEO environment needed to establish predictive models for future spacecraft designers. Nevertheless, an equally important goal is to investigate potential methods for decreasing the space radiation around spacecraft so as to protect them from solar storms and other radiation sources. The three distinct experiments planned for DSX's year-long mission will significantly improve DOD's capability in this attractive orbital regime. Let's now review each one.

The Wave Particle Interaction Experiment (WPIx) will transmit and receive very low frequency waves in the 10 to 50-kilohertz range and quantify their effect on the trapped electron populations in the magnetosphere. DSX will also utilize ground transmitters and other space receivers to measure critical parameters such as VLF injection across the ionosphere and the far-field radiated patterns.

The DSX Space Weather Experiment (SWx) will characterize the high and low energy electron and proton fluence, radiation dose rates, local magnetic fields and pitch angle distribution or radiation particles in the slot region orbit.

Last but not least, the space environment effects experiment consists of NASA's Space Environment Testbed (SET), as well as several AFRL-developed photometers and radiometers. The SET will employ several sensors to characterize a broad spectrum of energetic particles and its effects on electronics, such as radiation displacement damage and single event effects (SEE). Conversely, the AFRL instruments will be used to characterize optical and thermal property degradation of several spacecraft materials of interest.

DSX will benefit the joint warfighter by greatly enhancing our understanding of the MEO environment, with particular emphasis on the slot region attractive for future space surveillance and high-speed communication. In addition, DSX will perform the basic research needed to assess man's ability to actively regulate agitations to the space weather environment that currently cause accelerated degradation of critical space assets.

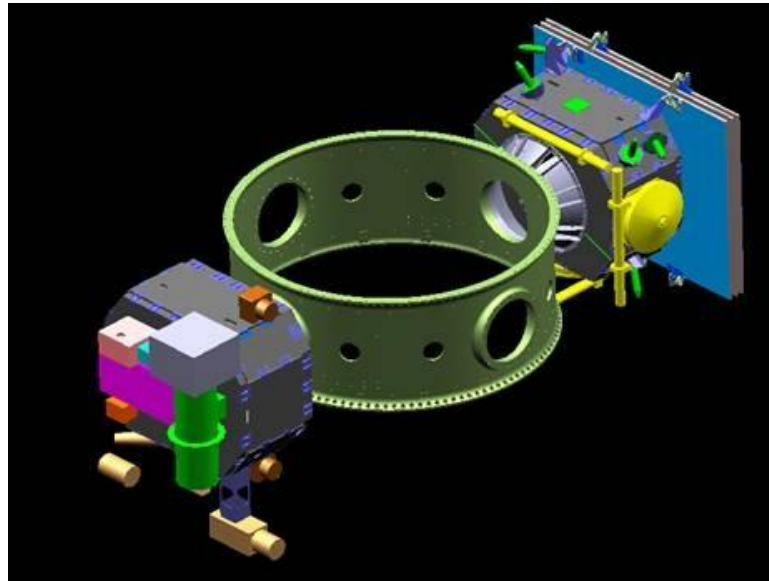
"We have designed DSX to be a cutting edge base of research for the warfighter's needs for communication, surveillance, and navigation," Dr. Spanjers said.

The Space Vehicles Directorate will provide a bulk of the funding for the \$37 million spacecraft, but other financial contributors include DARPA, NASA, and the Propulsion Directorate, which is located at Edwards Air Force Base, Calif. Finally, the program is operating on schedule and on budget, as well as on the path towards accomplishing a spacecraft bus critical design review in early 2006.

Like the phrase “To boldly go where no one has gone before” from the *Star Trek* television series, DSX will set the standard for the future of research and development technology employed in space.



DSX Program Manager Dr. Greg Spanjers, Air Force Research Laboratory, Space Vehicles Directorate (right), discusses the research and development spacecraft project with Aaron Adler, contract aerospace engineer, Jackson and Tull (left), and Jason Guarnieri, Aerospace engineer, AFRL, Space Vehicles Directorate. The innovative satellite is scheduled to launch in 2008. (Photo by Michael P. Kleiman)



DSX satellite in stowed configuration on the evolved expendable launch vehicle secondary payload adapter ring (Graphic courtesy of Dr. Greg Spanjers)